wheels and convert it into electric energy. Therefore, it will be seen at once that an electric generator is not a prime mover, but merely a secondary machine. That is to say, it does not directly convert a naturally stored amount of potential energy into electrical energy, but merely receives mechanical energy from a prime mover, such as a water wheel or steam turbine, which it converts to electrical energy. Thus, a little cell of dry battery occupies the position of prime mover, while an electric generator, however large, is merely a converter of energy from the mechanical to the electrical form. The cell of dry battery converts the energy which is stored in the battery in the form of chemical potential energy.

Before a water wheel can be tested, one must be able to estimate the potential energy of the waterfall. Since a pound of matter of any kind falling a vertical dstance of one foot will lift an equal weight one foot, it is very easy to see that work may be measured in terms of a unit, appropriately called the foot-pound. This unit shows clearly that water energy is a compound quantity, consisting of *weight of water* and *height of fall*. There can be no waterpower without both *water* and *fall*. Hence, a current wheel in a river, tho truly a prime mover, can never be of any great service, on account of the smallness of the fall availble to it. It is also very important to notice that fall is relatively more valuable than water, since the greater of two waterfalls, as regards height of fall, can be developed with smaller, and therefore cheaper, machinery per horsepower.

MR. PARKS IN AN ATTRACTIVE ROLE

The Falls turbines each require about 110,000 pounds of water per second; and since there is a fall of about fifty feet, there are available a total of 110,000 x 50=5,500,000 foot-pounds per second.

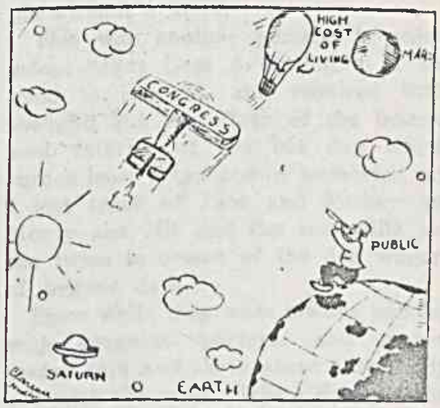
Since a horsepower represents the conversion of energy at the rate of 550 foot-pounds per second, there is available at Yadkin Falls a total power for one wheel of 5,500,000÷550=10,000 horsepowers.

There are several methods of determining the amount of water furnished a water wheel. One method consists in building a weir, either upstream or downstream from the wheel. By knowing the height of water on the crest of the weir, the weight of water in pounds per second can be found. Another method is that which employs a current meter; while still another employs the pitot tube. But the method adopted at the Falls is the chemical method.

In the chemical method, a certain chemical which can easily be measured in the water discharged by the turbine is injected into the water supplied the turbine. The water supplied the turbine is called "headwater," and that discharged by the turbine is called "tailwater." The latter must be equal to the former, or there are leaks which must be stopped before the test can be made. The chemical employed at the Falls is common salt. It is possible to measure with great accuracy the amount of salt in a pound of water, even tho the quantity is as small as three ten-thousandths of a pound.

This is just what is done in test. About sixteen and a half tons (33,000 pounds) of salt are dissolved in a 15,000 gallon tank, and this is allowed to be emptied into the headwater at a fairly uniform rate. The turbulence in the water and the water wheel make a uniform "mix" of salt and water as it flows thru the wheel. Small samples of the mix are taken from the tailrace, and sent to the laboratory to be tested for salt. It is there found that each pound of water contains about .0003 of a pound of salt.

As a test lasts about 16⅔ minutes, or one thousand seconds, the rate at which salt is injected into the water is thirty-three pounds per second; and this salt is uniformly distributed thruout the water that flowed thru the water wheel during that same second. Therefore, the total number of pounds of water that flowed thru the water wheel in that second may be found by dividing the quantity of salt injected during that second by the amount of salt in a pound of the tailwater. Thus there would be 33÷.0003=110,000 pounds of water per second.



A LOOSE BALLOON.

The power developed by the generator driven by the water wheel is also measured during the test. It is plain to be seen that this power, divided by the power supplied by the water to the water wheel during the test, must be the combined efficiency of the water wheel and generator considered as a single machine. The combined water wheel and generator at the falls actually develops nearly nine thousand horsepowers when being supplied with 110,000 pounds of water per second on 50-feet head, that is, with ten thousand horsepowers received from the water as calculated above. Thus the hydro-electric generators at the Falls are capable of developing nearly ninety per cent. of the power received from the water; or they are nearly ninety per cent. efficient. This is extremely high, as, until very recently, hydro-electric generators have scarcely attained more than eighty-five per cent. on the water wheel and ninety-six per cent. on the generator, or a combined efficiency of 85×0.96=81.6 per cent. When the hydro-electric units at Massena were tested, in 1914, and found to have an efficiency of eighty-five per cent. from water to bus bars, it was thought to be a very fine performance.

The testing engineers at the Falls are F. W. Ely, in charge of hydraulics; R. C. Bromelmeier, assisted by J. B. Cochrane, in charge of chemistry; and R. F. Giersch, in charge of electricity. These gentlemen were further assisted by W. H. Graham, C. M. Ramsey, O. D. Holzhauser, B. L. Smith, P. R. Tysinger,